

Regional Simulation Model (RSM) Benchmark Guide

RSM Version 2.2.9

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Chapter 1

Introduction To RSM Benchmarks

Welcome to the South Florida Water Management District's (SFWMD) Regional Simulation Model (RSM). The RSM is a general hydrologic computer model developed over the past 10 years by the SFWMD in West Palm Beach, Florida. RSM is capable of simulating a wide range of hydrologic conditions, although it has been developed principally for application in South Florida. The RSM is developed on a sound conceptual and mathematical framework that allows the RSM to be applied in a wide range of hydrologic situations.

The RSM simulates the coupled movement and distribution of groundwater and surface water throughout the model domain. The RSM currently has two principal components including the Hydrologic Simulation Engine (HSE) and the Management Simulation Engine (MSE). The HSE is capable of simulating the natural hydrology, water control features, water conveyance systems and the storage systems of South Florida. The HSE solves the governing equations of water flow through both the natural hydrologic system and man-made structures. Future versions of RSM will also be able to simulate water quality. The MSE allows water management functionality to be applied to HSE simulations.

During the model development lifecycle, the RSM model has been continually tested against a series of benchmark test cases. These test cases have expanded over time as more functionality has been added to the model. This manual provides an overview of these test cases.

1.1 Background

The Regional Simulation Model (RSM) has been developed to provide a tool to simulate the hydrology and man-made water control features of South Florida. This model represents the next generation of integrated water management modeling and therefore contains many new

features and concepts. To assure that the model is computationally sound and does not get corrupted during development, a series of benchmarks are maintained and used to test the integrity of the code over time.

Chapter 2

Model Validation Benchmarks And Test Cases

Complete descriptions of all benchmarks can be individually accessed with hyperlinks as shown in [Table 2.1](#)¹. For user's wanting a complete benchmark guide, a complete listing of all benchmarks can be obtained [here](#)².

The benchmarks use a variety of meshes to simulate the test cases. Many of the cases are solved using the 3x3 finite volume mesh is shown in [Figure 2.1](#). Several cases use this same grid, but with a canal superimposed on the mesh as shown in [Figure 2.2](#). Five additional meshes have been developed for different cases. These meshes are shown in [Figure 2.3](#), [Figure 2.4](#), [Figure 2.5](#), [Figure 2.6](#), and [Figure 2.7](#).

¹<http://gwmftp.jacobs.com/benchmarks/BM1/BM1.pdf>, for example

²http://gwmftp.jacobs.com/benchmarks/bm_des.pdf

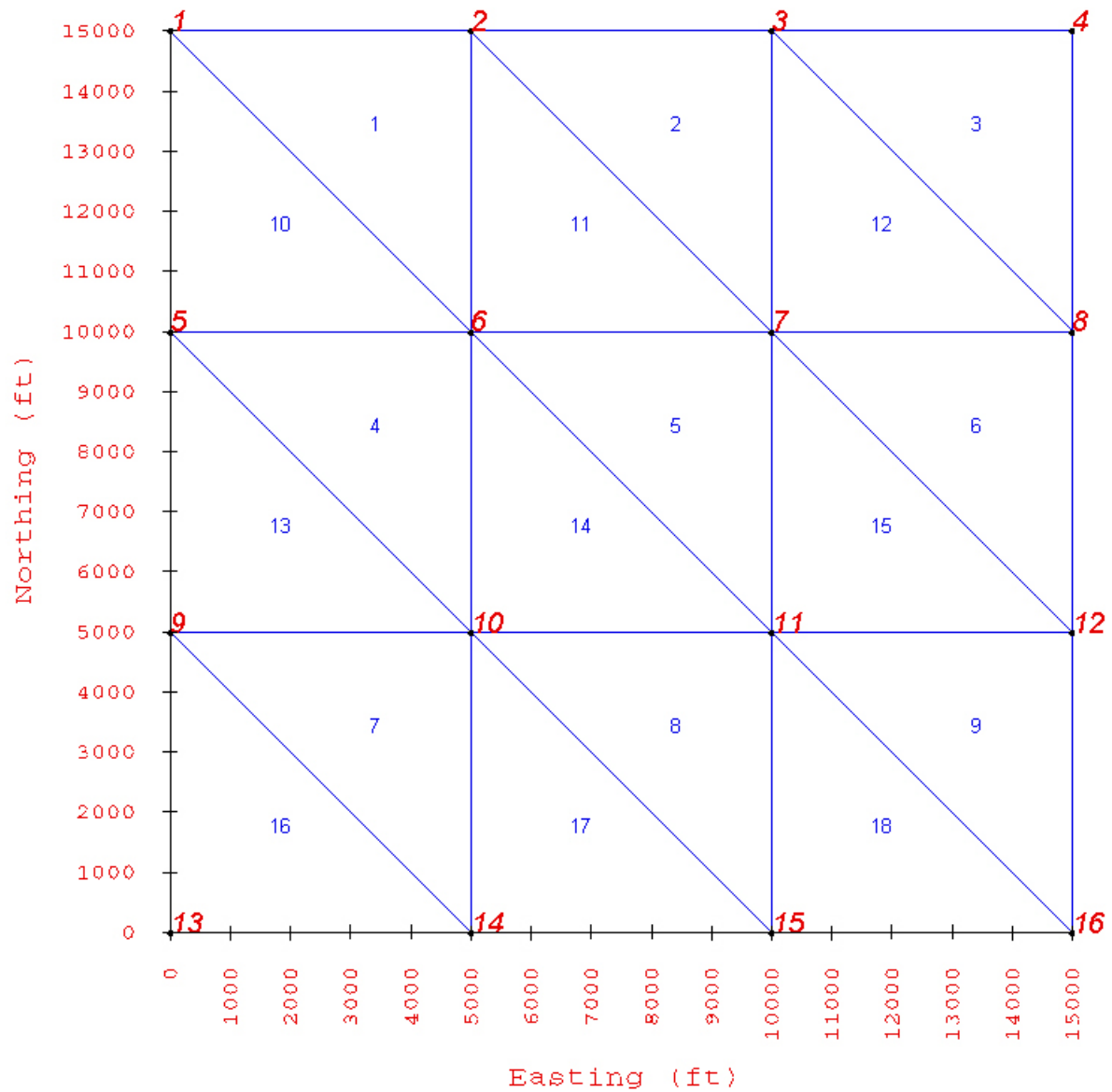


Figure 2.1: 3×3 finite-volume mesh used for many of the benchmarks listed in [Table 2.1](#).

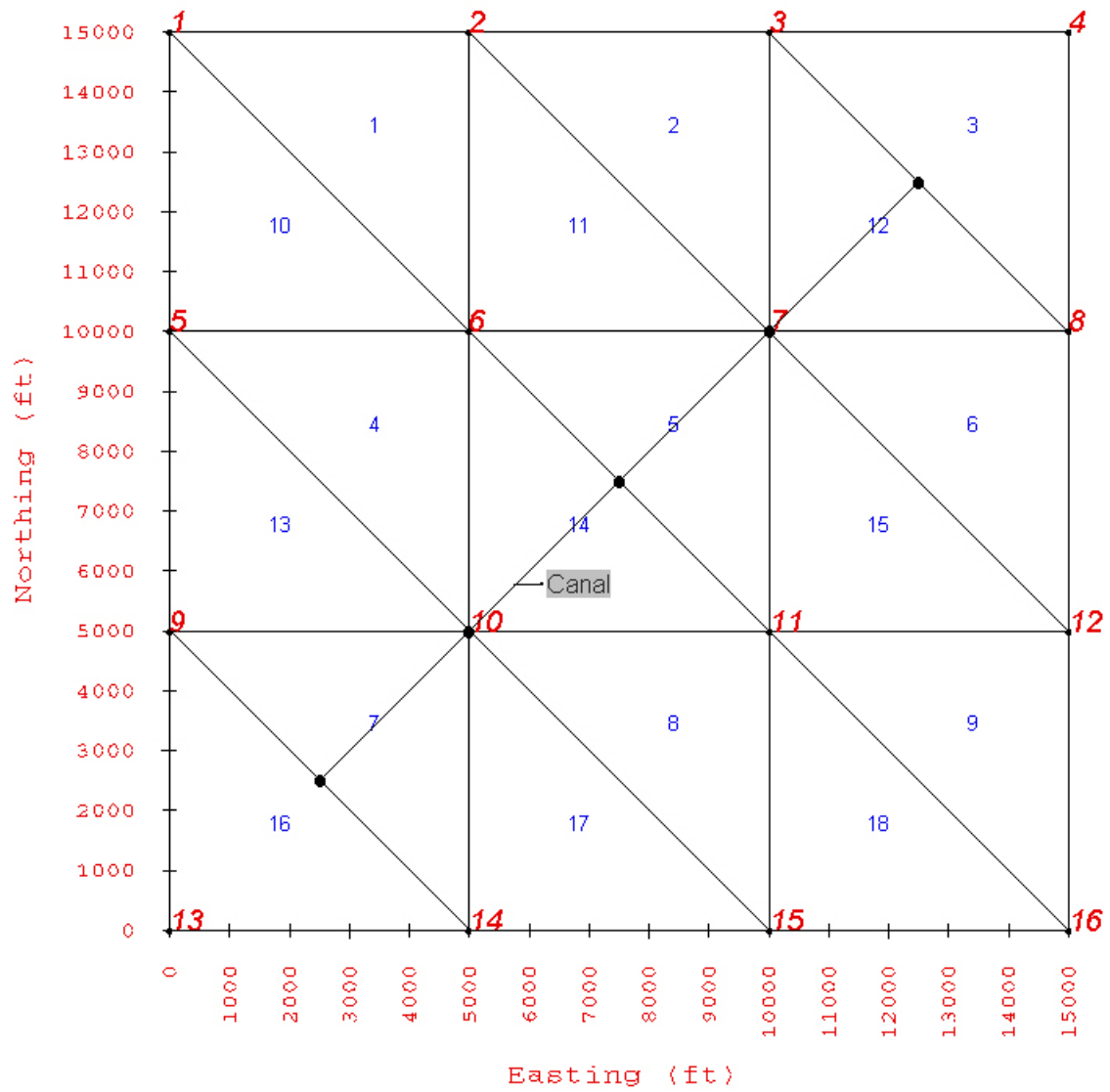


Figure 2.2: 3×3 finite-volume mesh with canal used for many of the benchmarks listed in [Table 2.1](#).

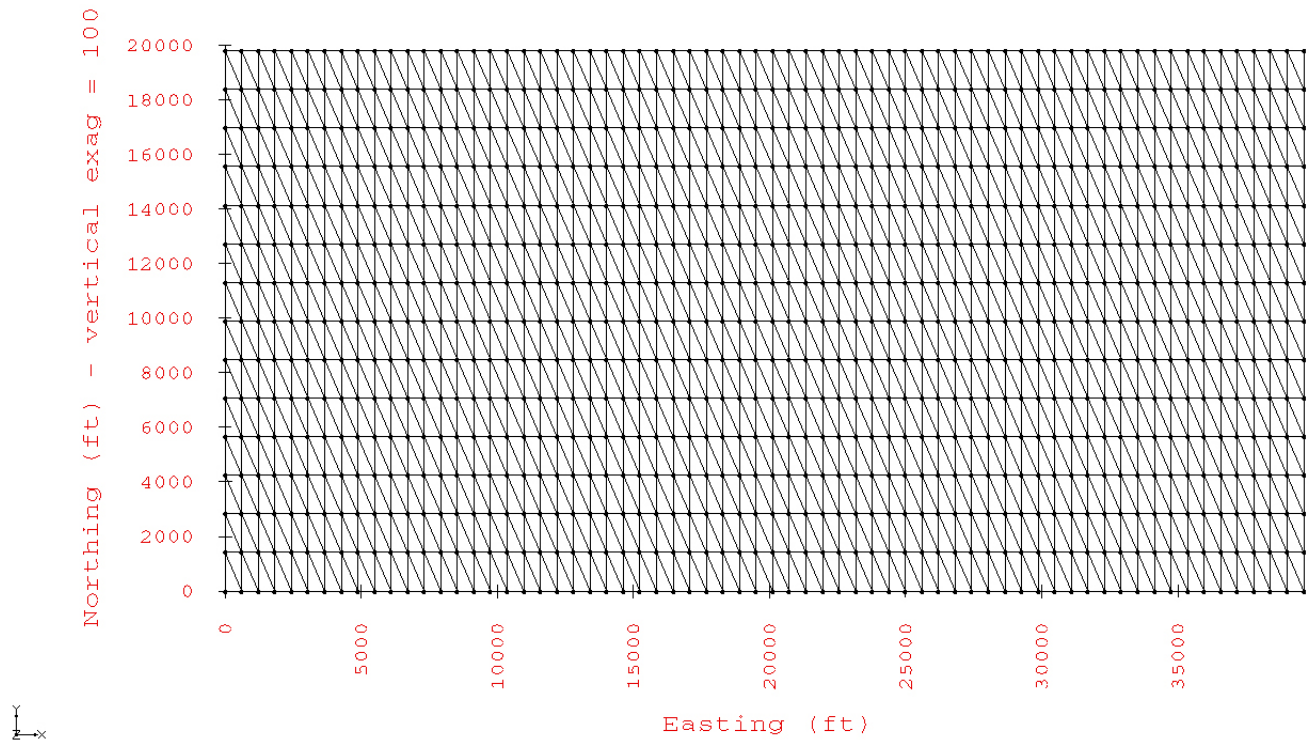


Figure 2.3: *Pinder finite-volume mesh used for benchmark 11 in [Table 2.1](#).*

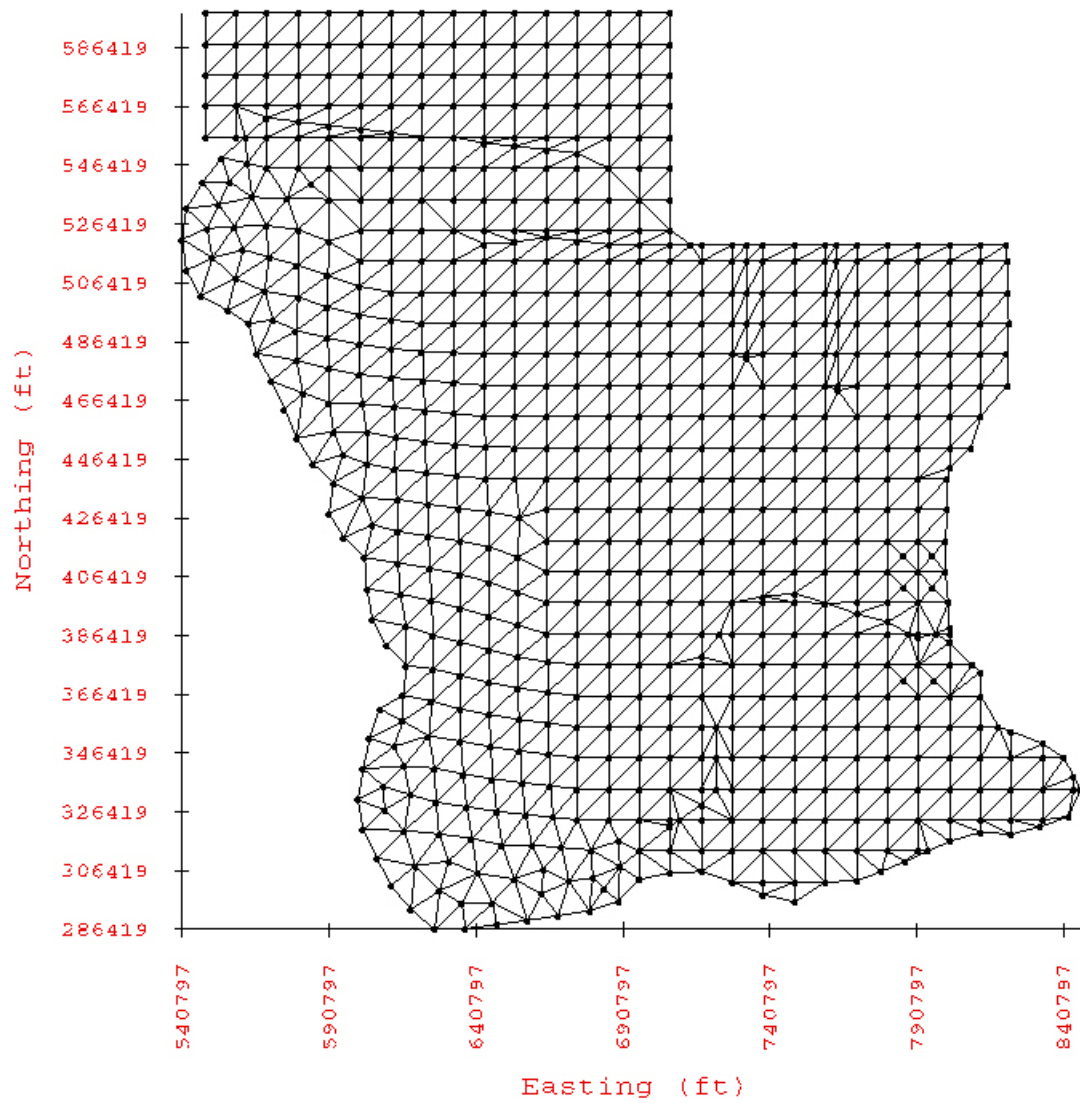


Figure 2.4: *Everglades National Park finite-volume mesh used for benchmarks 30 and 31 listed in Table 2.1.*

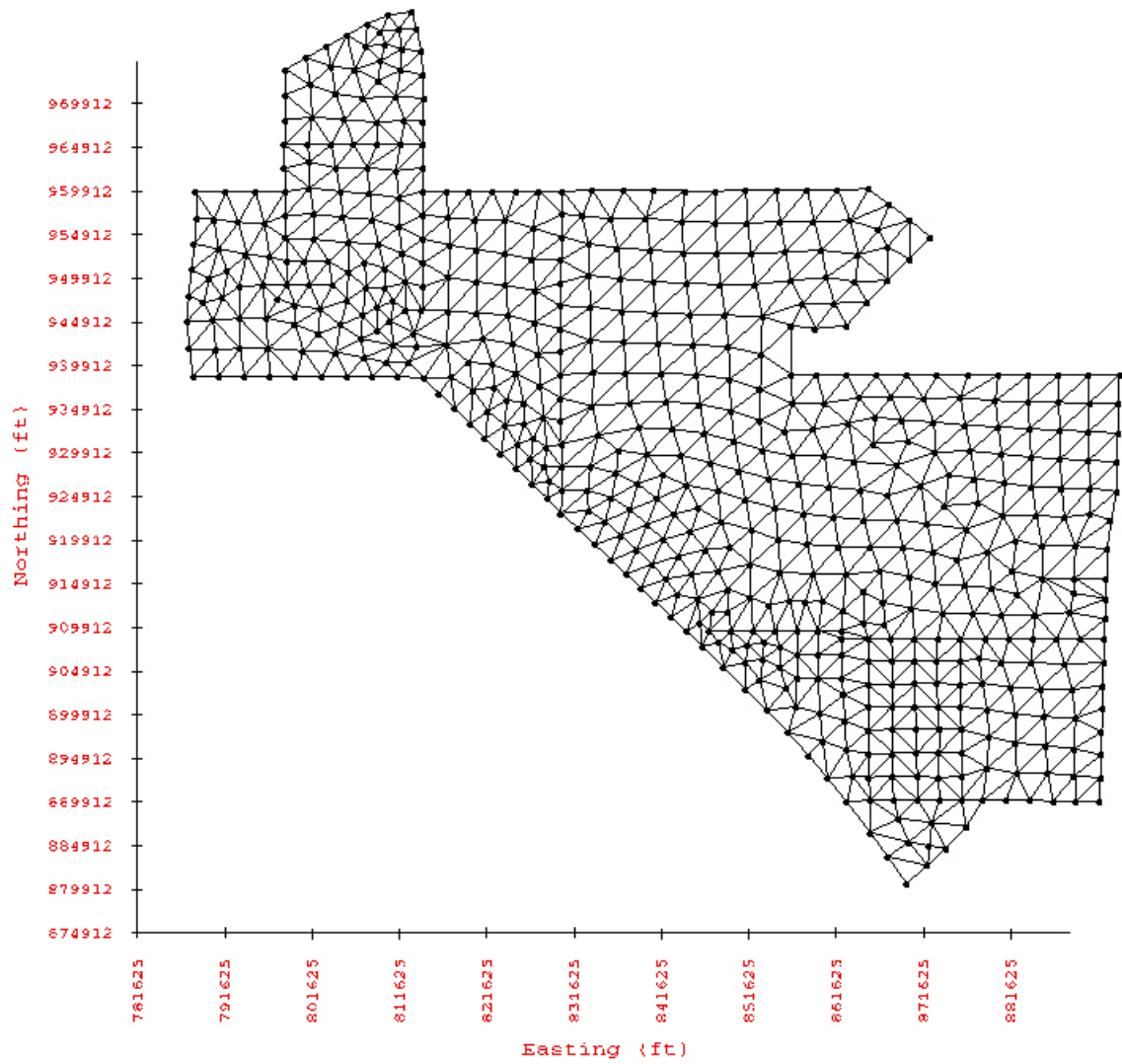


Figure 2.5: *L8 finite-volume mesh with canal used for benchmark 34 listed in [Table 2.1](#).*

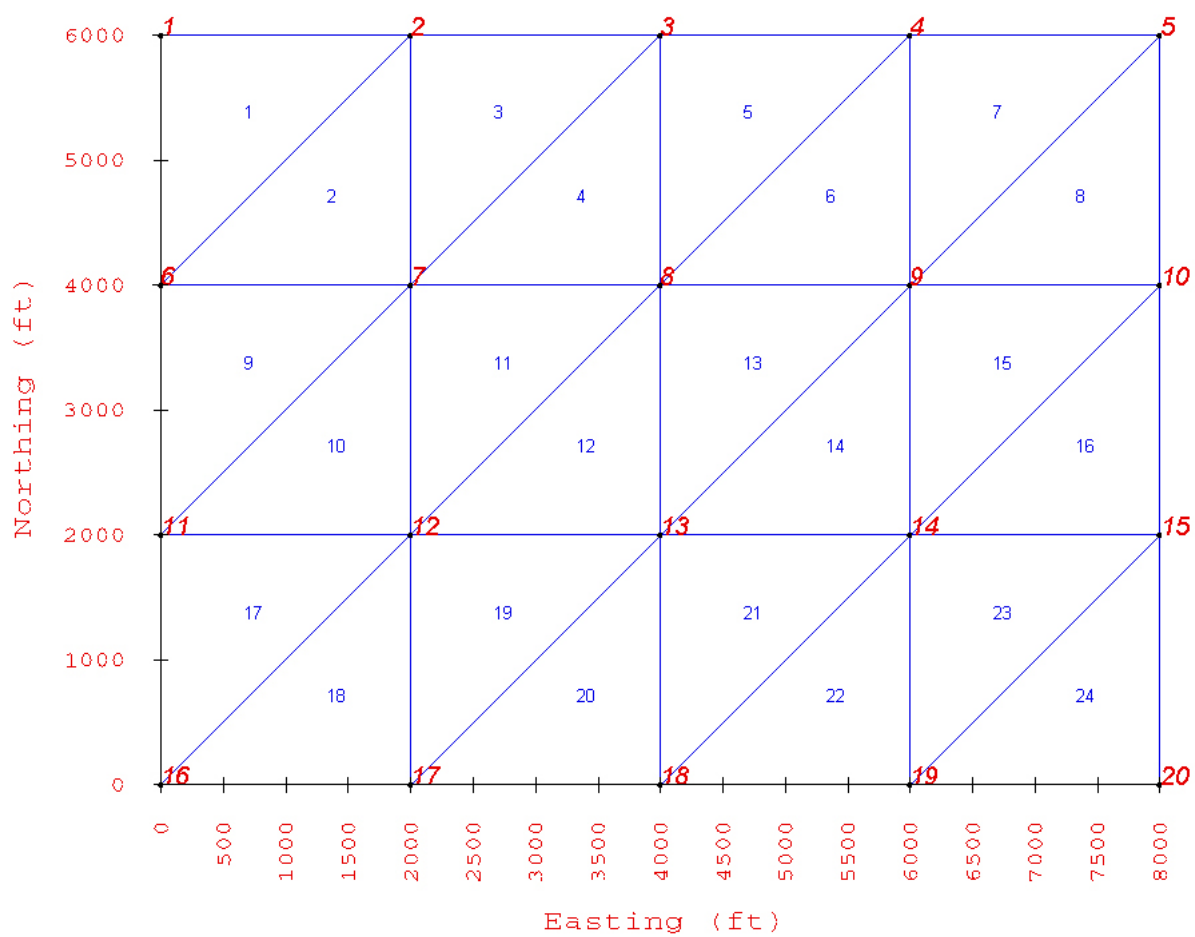


Figure 2.6: 3×4 finite-volume mesh used for bermseepage in benchmark 59 listed in [Table 2.1](#).

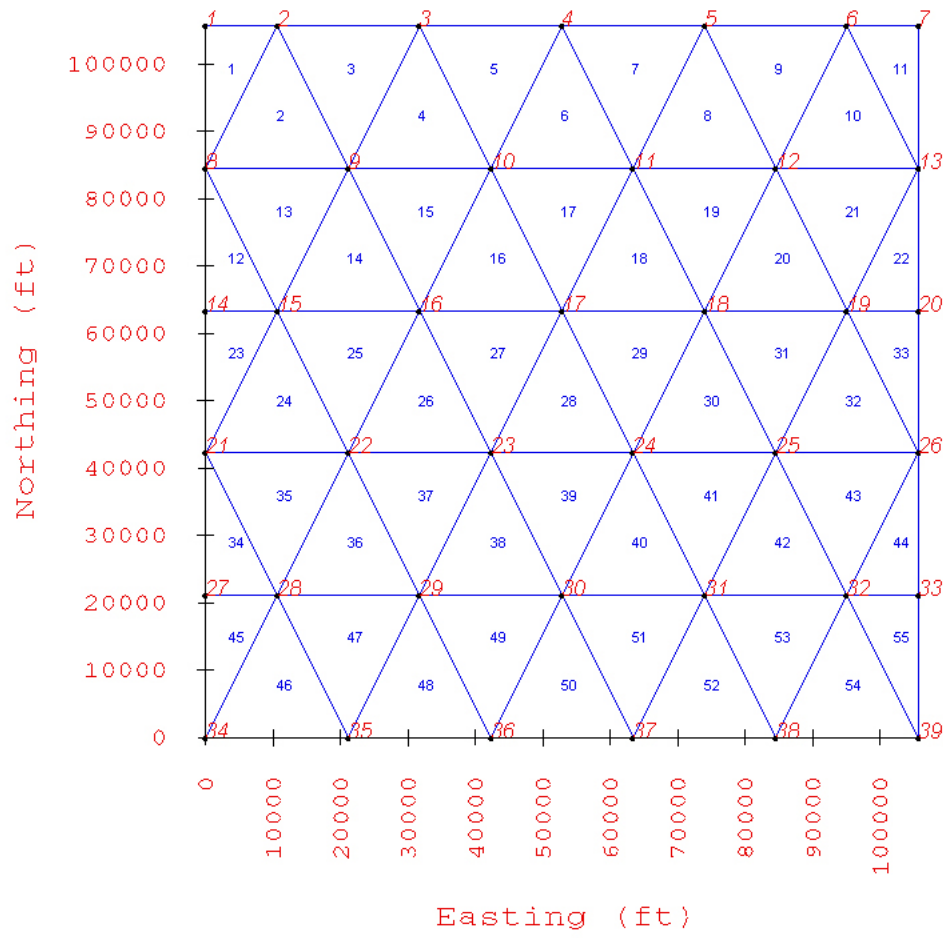


Figure 2.7: 5x6 finite-volume mesh used for routing in benchmark 63 listed in [Table 2.1](#).

Table 2.1: *Benchmarks established for the HSE, hyperlinks yield full descriptions*

Hyperlink	Mesh/Network	Feature Tested
BM1	Figure 2.1	Overland flow
BM2	Figure 2.1	Overland and groundwater flow
BM3	Figure 2.2	Canal flow
BM4	Figure 2.2	Overland flow, gw flow, canal flow, and streambank.
BM5	Figure 2.1	Single_control watermovers
BM6	Figure 2.1	Steady state solution
BM7	Figure 2.1	Pumping wells
BM8	Figure 2.1	5-layer HPM
BM9	Figure 2.2	Dual_control watermover
BM10	Figure 2.2	Head boundary conditions
BM11	Figure 2.3	GW flow, canal flow and mesh to canal interaction
BM12	Figure 2.1	General head boundary conditions
BM13	Figure 2.1	Lakes and ponds
BM14	Figure 2.2	Culverts
BM15	Figure 2.1	Indexed entry of HPMs
BM16	Figure 2.1	Nsm1layer HPM, w/ampmod feature
BM17	Figure 2.1	Svconverter lookup table
BM18	Figure 2.1	Unsat HPM
BM19	Figure 2.1	Output options, including netcdf
BM20	Figure 2.2	Single_control watermover (segment h20)
BM21	Figure 2.2	Single_control watermover (cell h20)
BM22	Figure 2.2	MBR pipes
BM23	Figure 2.2	Three MBR weirs
BM24	Figure 2.1	Indexed entry of rain and refet
BM25	Figure 2.1	Mbrcell HPM
BM26	Figure 2.2	Three MBR bleeders
BM27	Figure 2.2	Canal streambank implementation
BM30	Figure 2.4	Include external files, mesh and network bc's
BM31	Figure 2.4	Separate type conveyance , like BM30
BM33	Figure 2.1	Afsirs HPM
BM34	Figure 2.5	Wts2pt wallhead, various conveyance formulations
BM35	Figure 2.1	General head boundary imposed on walls
BM36	Figure 2.1	Lookup tables for conveyance and transmissivity
BM37	Figure 2.1	Lookup table for soil storage coefficient
BM38	Figure 2.1	Kadlec formulation for conveyance

Table 2.1 continued on next page

Hyperlink	Mesh/Network	Feature Tested
BM40	Figure 2.2	Pidctrl controllers
BM41	Figure 2.2	Setpointctrl controllers
BM42	Figure 2.2	GHB boundary conditions
BM43	Figure 2.2	Fuzctrl controllers
BM44	Figure 2.2	Upwind methods in overland and canal flows
BM45	Figure 2.2	User Defined controller
BM47	Figure 2.1	GLPK optimization problem
BM48	Figure 2.1	MSE network rep. and HSE to MSE network mapping
BM49	Figure 2.1	MSE network rep. and HSE to MSE network mapping
BM50	Figure 2.1	HPM hub
BM51	Figure 2.1	Impervious HPM
BM52	Figure 2.1	Urbanet HPM with transient wallhead bc's
BM53	Figure 2.1	Urbanhub HPM with urbanhub feature
BM54	Figure 2.1	Urbanhub runoff and wsupply routing
BM55	Figure 2.1	Urbanhub consumptive use and return flow
BM56	Figure 2.1	Precipitation runoff model (nam or prr) HPM
BM57	Figure 2.1	One2many, pumpedditch and agimp
BM58	Figure 2.1	Lake boundary conditions
BM59	Figure 2.6	Berm seepage
BM60	Figure 2.1	Trigger module
BM61	Figure 2.1	Wave propagation in a canal and mesh
BM62	Figure 2.1	ORM supervisor
BM63	Figure 2.7	Flood routing, water supply, seasonal routing and supervisors
BM64	Figure 2.1	Tests arcverticies to define canal segment shape